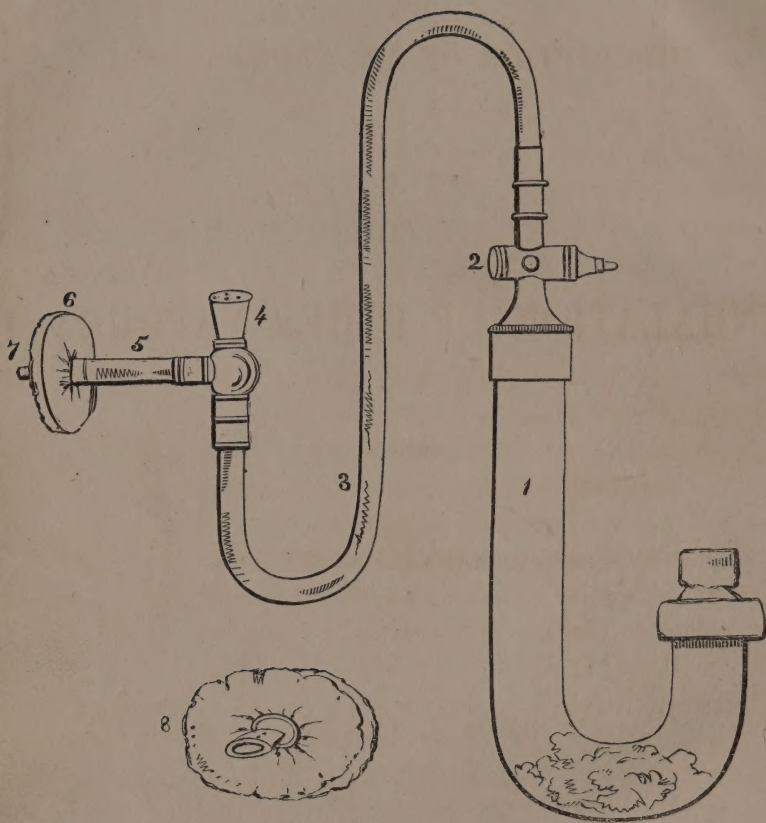




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DESCRIPTION OF APPARATUS.

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|--|-----------------------------|
| 1. Glass Tube. | 4. Double Valve. |
| 2. Ferguson's two-wayed Stop-cock, for the admission of Ether Vapour or Atmospheric Air. | 5. Elastic Medium. |
| 3. Elastic Tube. | 6. Mouth Pad. |
| | 7. Mouth Tube. |
| | 8. Front View of Mouth Pad. |

A

DESCRIPTION OF AN APPARATUS

FOR THE

INHALATION OF ETHER VAPOUR;

WITH

SOME REMARKS ON ITS USE.

BY S. J. TRACY.

LONDON:

D. FERGUSON, GILTSPUR-STREET, SMITHFIELD.

1847.

PREFACE.

HAVING described a Tube in the Medical Journals, which I proposed for the inhalation of Ether Vapour, and having received several communications upon it, some of them conveying wishes that a more detailed account of its application and its uses had been given, I have been induced to print the following pages.

Should they impart any information to those who have inquired, my object will be gained.

S. J. T.

ST. BARTHOLOMEW'S HOSPITAL,
March 25, 1847.



A DESCRIPTION,

&c. &c.

AT the termination of the last year we received a communication from America, through Dr. Boott, which will mark that epoch in the annals of medical history as one of stirring interest to the profession and to suffering humanity. The introduction of the vapour of ether for the annihilation of pain during surgical operations came upon us as a fact without preface, but as one bearing so much of probability, that the whole profession was at once prepared to entertain it. Little or no account of its application came to us with the intelligence of its discovery, save that Drs. Jackson and Morton, dentists, of Boston, had found that ether vapour had produced insensibility to pain during the extraction of teeth ; so that it was left to the ingenuity of our countrymen to carry out the application of the fact.

Immediately on its becoming known in this country, Mr. Skey requested me to extract some teeth from patients under its influence; and for that purpose Mr. Ferguson, instrument-maker to the hospital, supplied us with a common vapour inhaler, which was charged with ether.

The patients, after inhaling through the apparatus for a short time, appeared to be insensible when I extracted their teeth. It proved that three knew that their teeth had been extracted, but felt no pain; whilst the fourth neither knew that his tooth had been extracted, nor felt any pain—at once proving to us the accuracy of the communication and the value of the discovery. That the inhalation of ether vapour is not altogether new, is proved from the following passage in Dr. Pereira's *Materia Medica*,* containing a description of its effects:—"When the vapour of ether, sufficiently diluted with atmospheric air, is inhaled, it causes irritation about the glottis, a sensation of fullness in the head, and effects analogous to those caused by the protoxide of nitrogen (laughing gas): moreover, persons peculiarly susceptible of the action of the one, are also powerfully influenced by the other.

* See Sulphuric Ether, p. 375.

If the air be too strongly impregnated with ether, stupefaction arises. In one case this state continued, with occasional periods of intermission, for more than thirty hours; for many days the pulse was so much lowered that considerable fears were entertained for the safety of the patient. In another case, an apoplectic condition, which continued for some hours, was induced." Dr. Ure and Dr. Hue also administered ether vapour many years ago in a similar manner to laughing gas. These facts are not stated with a view of detracting from the merits of our transatlantic friends, for the real discovery remains unaffected, viz., the exhibition of the vapour of ether for procuring insensibility to pain during the performance of surgical operations.

We now continued to operate daily on the teeth with the various apparatus introduced, all of which proved more or less successful. Some were inconvenient in form, and others of so portly a shape, and all requiring so large an expenditure of ether, that we began to consider that the end might be obtained by an instrument of less dimensions, and requiring less expense in the preparation. I proposed a tube made of glass, sixteen inches in length, of the form of a German pipe, mounted on the top

with a brass cap and stop-cock,* into which an elastic tube is screwed, sixteen inches in length, surmounted by a double-valve, into which the mouth-tube is screwed, the extremity of the glass tube being closed by a stopper. The ordinary mouth-cap was hard, and produced pain when pressed against the patient's mouth, so that I constructed one of twelve thicknesses of flannel, and covered with morocco, somewhat of an oval shape, being five and a half inches in its long and four in its short diameter, having a hole in the centre, through which was screwed the mouth-tube.

In administering the vapour to a patient in the recumbent position, it was found that the valves would not act until the patient's head was raised and the valve-piece became perpendicular. To remedy this, I have secured the end of an elastic tube, three inches in length, into the valve-piece, which terminates in a mount, on which is placed a pad, and into which the mouth-tube is screwed. The bore of the glass tube is an inch and a half in

* We have now substituted the two-wayed stop-cock, so ingeniously contrived by Mr. Ferguson, (the manufacturer of the instrument,) which obviates the necessity of removing the tube from the patient's mouth during an operation, as it permits a free supply of atmospheric air when the ether vapour is shut off.

diameter in the whole of its course ; the elastic tube is half an inch in diameter ; the bore of the valve-piece being of equal size, and the mouth-tube corresponding with it, so that respiration can be carried on with ease through this apparatus.

In administering the vapour to a boy, he appeared to be approaching a state of asphyxia ; and this was proved to arise from putting his tongue against the hole of the mouth-tube. To prevent this from recurring, the mouth-tube is pierced by several transverse holes. A piece of sponge is placed in the bend of the glass, and as much ether as will prevent any air from passing except through the fluid is poured into it, when it is ready for use. The patient being placed in a convenient position, and the mouth-tube being put between the teeth, the stopper is removed and the stop-cock turned on, when the patient is requested to respire in a natural way. The person administering the ether should press the pad close to the patient's mouth, and, if he can tolerate it, should close the nostrils with the same. The compresses for the nostrils appear very objectionable, as most persons have a feeling of suffocation when their noses are compressed, which often induces them to offer con-

siderable resistance to the administration of the vapour. Should this occur, a little encouragement will induce them to continue to inspire through the apparatus, although some coughing may be induced by it.*

Each inspiration is proved by the rising of the ether in the tube, and the operator will find this aid him considerably in his judgment as to the probable effect of the vapour on the patient's system. As far as I have observed, all persons who have tried it have been placed more or less under its influence, thus proving that all, though not equally susceptible, may be affected by it. After a few inspirations the pulse becomes quickened, and in general, in about two minutes, it has increased twenty or thirty beats, the temperature of the surface having increased at the same time fifteen or twenty degrees, the pupil acts nearly up to this time, but now it becomes dilated; and if you have spoken to the patient from time to time, you will perceive by his answers, that from having first had

* I have invariably found that patients to whom the principles of inhalation are explained breathe it much more readily, and with less inconvenience, than those who, without any preface, are merely told to "do as they are directed."

a perfect consciousness of circumstances around, he has lapsed gradually into a state of unconsciousness.* This, I think, is the best and safest time to operate. In some persons considerable excitement is induced, bearing the character of hysteria, in others that of intoxication, not unfrequently requiring some force to control their actions; this, however, should be accomplished, and the application of the vapour continued; at last muscular energy ceases, and the patient is at your command. When it has been pushed thus far, insensibility appears to continue for from one to five minutes, when consciousness somewhat returns; and if the operation is to continue longer, I think it advisable now to give another dose, and so from time to time until the operation is concluded. We have observed that loss of sensibility to pain first occurs, and this is produced in a very short time, and

* I may here state, that the above effects are not confined to the sulphuric or pure ether. Other ethers are capable of affecting the system more or less in a similar manner; the chloric ether has moreover the additional advantage of a sweet taste, and on this account the preference may be given to its use in some cases. At present the acetic ether seems hardly to possess the power in comparison with the others, and its use moreover would be objectionable on other grounds. For a description of these, see works on Chemistry.

considerably before consciousness ceases,* so that not unfrequently patients give apparent signs of pain by sounds and muscular contortions, although they tell you afterwards that they have not suffered.†

From one operation on the jaw in this Hospital, which occupied ten minutes, the patient appeared to have experienced little or no pain; and in another out of the Hospital, which occupied a longer time, the sewing up of the wound only was felt, proving that its effects are of longer duration than we sometimes believe. A gentleman, from whom I extracted four stumps, seemed to know something of the last two; in two minutes from that time I extracted a fifth, which he told me was very painful, yet, strange to say, three minutes after I extracted a sixth, and when quite recovered he recollected but one extraction. If ether vapour be pushed further than when the pulse becomes rapid, the pupil dilated, and consciousness ceases; like narcotics in general, it diminishes the heart's action, so that the pulse can scarcely be felt at the wrist, respiration becomes slow and laboured, the blood is imperfectly oxygenated, and the skin presents a blue, and the

* See case 11.

† See cases 7 and 8.

patient generally an asphyxiated, appearance ; at this stage its effects altogether bear a close resemblance to those produced by large and poisonous doses of alcohol,* but they are more rapid and transient. It is daily matter of observation that persons under the influence of liquor are hardly susceptible of pain, and surgeons who have had occasion to operate under such circumstances have made the same remark. The question may be asked, on what part of the nervous system are the effects of ether chiefly produced? The facts observed during life as well as the morbid appearances found after death†, lead to the conclusion

* We have sometimes observed the above symptoms accompanied with a contracted state of the pupil, similar to that induced by opium.

† A healthy rabbit was made to inhale the ether vapour ; in about one minute from the commencement, the animal became totally insensible, the conjunctivæ suffused, and the pupils extremely dilated, and the breathing, slow, deep, but regular ; in three minutes more death ensued.—Post mortem. The muscles about the head were much darker than those of the rest of the body. On exposing the brain, the membranes and surface of that organ appeared in a highly congested state, and on cutting into the substance of the cerebrum the same appearance was remarked throughout. The spinal cord also showed some signs of congestion, though in a much less degree. The other organs of the body, with the exception of the lungs (also somewhat congested), were in a healthy state. The blood was darker than natural,

that when administered in moderate doses its effects are chiefly manifested in the cerebrum, given beyond this they become gradually extended, and so reaching to the spinal cord.* Ultimately death is produced.

I conceive ether vapour may be administered to patients of almost any age or temperament. We have applied it to persons from four to sixty-five years of age, neither studying their appearance nor

and coagulated most rapidly. The odour of ether pervaded the whole body. A second rabbit was subjected to the same process. Insensibility, &c. occurred in about the same time; the inhalation was now discontinued; in a short time consciousness began to return, when the exhibition of the vapour was repeated, and this alternate loss and return of sensibility was continued four or five times, the object being to impregnate the animal (if I may so speak) as completely as possible with the vapour. It was at length administered so as to cause death.—Post mortem. The whole of the brain and lungs were in much the same state as in the last experiment, but the spinal cord and its membranes were now also much congested, presenting a very different appearance to the same parts in the first animal.

* Vide a paper, by the author, in the *Medical Gazette*, Feb. 5th, 1847.—Etherization. From experiments made by Baron Flourens and M. M. Magendie and Serres, it appears that not only the cerebral but the spinal system is affected by the influence of ether. In their experiments not only were the nerves of sensation rendered insensible, but irritation of the spinal marrow produced no convulsive action. On the subsidence of the influence of the ether, the spinal marrow again resumed its excitability.—*The Lancet*, Feb 20th, 1847.

their habits, and in the great majority of cases with success. In some few, considerable congestion has been produced; when it has not been thought advisable to push it further. The average time which it takes to produce the desired effect is four minutes, in one case it was produced in twenty seconds, and in another it took twenty minutes. One person only who inspired it pretty freely, but who would not have his nostrils closed, failed to be affected by it, but he confessed that he could take a pint of gin without becoming intoxicated. He was a powerfully made man, with an iron constitution. There is no doubt that persons habituated to the use of stimulants can inhale the vapour of ether for a much longer period with impunity than others. Many of the unpleasant effects ascribed to the inhalation of ether vapour during the first experiments made with it, were no doubt owing to the imperfect way in which it was administered, as well as to the impurity of the ether used, for it is of the greatest importance that it should be exhibited as pure as possible. It would be useless to enter either upon the manner or theory of its formation, such information may be found in all chemical and pharmaceutical works, but a few particulars con-

cerning its properties when pure, and the mode of rendering it so when suspected, may not be altogether inappropriate here. The specific gravity of ether at 60° Fahrenheit is, according to the best experiments, 0·713. In the London Pharmacopœia, its specific gravity at 62° Fahrenheit is fixed at 0·750; when of specific gravity 0·720, its boiling point ordinarily is about 98° Fahrenheit.* It should speedily and totally evaporate in the air. When pure and recently prepared it has neither acid nor alkaline properties, but it must be remembered that by exposure to air and light it absorbs oxygen, by which acetic acid and water are produced. This, therefore, must be guarded against, as the vapour of such a mixture as this when inhaled would give rise to severe coughing, a sense of suffocation, &c. The acid, moreover, is not directly observed, as it combines with the ether, producing acetic ether. One volume of ether is soluble in nine volumes of water. It dissolves the volatile oils, resins, most of the fatty substances, some of the vegetable alkalies, iodine, bromine, sulphur, phosphorus, &c. The ether of commerce is usually contaminated with small quantities of either spirit or

* Vide Pereira's *Materia Medica*, article ether.

water, or both. These augment its specific gravity. It may also be contaminated with sulphurous acid, or oil of wine, formed in preparing it, but this is of less frequent occurrence. Ether, when absolutely pure, cannot be solidified by any degree of cold hitherto produced. It should not become milky when mixed with water. Alcohol may be detected by its coagulating the serum of the blood; pure ether will not do this; water may be detected by its volume becoming less when agitated with a concentrated solution of chloride of calcium.

Ether when suspected may be purified by rectification, it can be effected by the addition of carbonate of potassa and distillation. In order to separate alcohol from ether, shake the ether with twice its bulk of water, and allow them to separate. Pour the ether off. The water which the washed ether has now dissolved, as also any which it may previously have contained, may be removed by adding some freshly burnt lime, and distilling the ether a second time. For reasons before stated, ether should have no influence on litmus paper. The presence of an acid may be thus detected.

It has neither an acid nor alkaline reaction when pure. The specific gravity of ether vapour (Gay

Lussac) is 2·586, and when mixed with oxygen or atmospheric air, it should be remembered that it forms a violently explosive mixture, and that fatal accidents have occurred from this cause. According to ^{Ward} ~~Dalton~~, the thermometer being at 62° Fahrenheit, in 100 cubic inches of air saturated with ether, there will be ether 41·4, air 58·6. This appears to be the best temperature at which to administer it. A patient who was to have a finger amputated, commenced inspiring through my apparatus with a thermometer in it at 62° Fahrenheit; he inspired for five minutes when the mercury stood at 50°, indicating a decrease of 12°; and we found in two other experiments a corresponding decrease of temperature. At 50° Fahrenheit, in 100 cubic inches, ether is 31·2, air 68·8; and as the inhalation proceeds, the decrease becomes remarkably rapid. This might suggest to us some practical rule in using ether vapour. If the quantity of vapour given off at 62° Fahrenheit be sufficient to produce insensibility, without producing irritation or coughing, it should be our aim to keep the ether as near that temperature as possible, and it may be managed thus: after the inspiration has been carried on through the tube for two minutes or so, the bowl

or bend of the tube may be held in the palm of the hand; and when it becomes sensibly colder, it may be enveloped in a warm sponge, and from time to time this may be changed during an operation. 'The tin apparatus' I have seen in use, containing hot water, appear to produce so rapid an evaporation of the ether that few persons can bear so large a per centage of ether vapour; and the large apparatus' containing a great quantity of sponge become so cold when inspiration has been carried on through them for some time, that very little vapour can be given off, so that it is not surprising that they often fail in producing the desired effect.

The following cases are illustrative of some of the foregoing remarks, and are intended to show the general effects of ether vapour on the system. I may here state that I have extracted teeth from 500 persons whilst under its influence, and have administered it in all the large operations at this hospital, and I believe I may add with the approbation of all the surgeons here, and certainly no untoward results have occurred which can be attributed to its inhalation.

The cases comprise three amputations of the thigh, two of the leg, two of the fore arm, one

toe, five fingers, one removal of necrosed bone from a tibia, one fistula of the cheek, two extirpations of the eye, two herniæ, two extirpations of breasts, one tumour from the vagina, one excision of the jaw, one incision in the perineum, one cæsarian, and two dislocations of the humerus.

CASE 1.—A young lady, of a somewhat nervous temperament, wished to have two teeth extracted. She inhaled ether vapour for three minutes, when the pulse became accelerated, the countenance somewhat flushed, and the heat of the surface increased. She was much excited and pushed the tube aside. I persuaded her to resume the inhalation, when in two minutes we had a similar state of things; I administered it a third time, and she continued to inhale it until the pulse became slower than at the commencement, and the pupil dilated and fixed. I then extracted two teeth. In about four minutes she was sufficiently conscious to detect her loss. She remained with me for an hour, and repeatedly insisted that I came in a cloud and extracted her teeth; she went home and was a little feverish and absent in her manner, and very forgetful, but still the vision of the operator was constantly presenting itself to her mind. This gradually went off, but

she was not quite well for forty-eight hours. A fortnight after, this lady wished me to extract four more teeth; and although I did not like some of the symptoms which had occurred, yet I consented, and as nearly as possible the same state of things presented themselves, except that this time she was under the influence of ether for seventy-two hours.

In several other cases where a potent quantity was taken, drowsiness continued for some hours, but none to the extent of the above.

CASE 2.—A lady who was to have a tumour taken from the os uteri, wished to have ether; I administered it to her, and kept her under its influence for forty-five minutes; and in another case, a little boy inspired it for twenty-five minutes: both these patients did well.

CASE 3.—A Dutch Jewess of delicate appearance, enceinte (seven months,) came to the hospital and wished to have a tooth extracted; we gave her ether, she was but little excited by it, and went away without having suffered any pain. It is now six weeks since, and she continues well.

CASE 4.—A gentleman, ætat 37, had suffered many years from spasmodic asthma, and at the

suggestion of his medical attendant tried ether vapour. It cut short the paroxysm, and probably it will be the means of palliating, if not of curing, one of the most distressing and obstinate maladies.

CASE 5.—A man was to have his finger amputated. After inhaling ether vapour for five minutes he became insensible to questions put to him; the operation was now performed, and in about five minutes he returned to sensibility, and was thankful that it had been done without his knowing any thing about it.

CASE 6.—A young woman, *ætat* 23, of tolerably healthy appearance, with diseased knee-joint, was placed upon the table. She inspired for two minutes without having her nostrils closed; her pulse was somewhat accelerated, her face flushed, but she remained sensible: in three minutes more her pulse had risen to 115, twenty-five beats more than when she commenced inhaling. Respiration was now deep and full, face flushed, pupil dilated and fixed, skin considerably increased in temperature, and she was insensible when spoken to. The operation now commenced, when the tube was taken from the mouth. The thigh was amputated, and dressed.

She had been unconscious of the operation, and had felt no pain. No unpleasant symptoms presented themselves, and the patient is now well.*

CASE 7.—A man with disease of the lower jaw, requiring the removal of its greater part, inhaled ether vapour for eight minutes, when the operation was commenced. When the bone was sawn through he appeared to suffer pain. The operation was now finished except sewing up the wounds; at this time some blood irritated his glottis, so that he coughed violently, and appeared to be almost suffocated. This and the subsequent closing of the wounds was all he remembered of the operation.

CASE 8.—A child, *ætat* 5½ years, with disease of the eye, (supposed to be melanosis,) was placed upon the table. The vapour was administered, and the child was under its influence in twenty seconds; although he cried, and gave other apparent signs of pain before the operation was half over, yet afterwards he did not remember to have suffered at all.

CASE 9.—A gentleman wished to have the first

* I have in this (as well as in most other severe operations,) allowed the patient to practise the inhalation a few hours before being placed on the table; thus testing its effects on the particular case, and at the same time removing the fear induced by its novelty at the time of the operation.

lower molar on each side removed; he inhaled through the apparatus, and when I considered him under the influence of ether (which took five minutes,) I operated. He recovered himself somewhat in two minutes, and not being aware that his teeth had been extracted, passionately exclaimed, "You call yourself an experienced hand! I have been here three-quarters of an hour, and you have done nothing for me." I humoured him, placed him again in the chair, and pretended to extract his teeth; at this moment he was conscious of the ruse, and burst out laughing, expressing himself (as most others do) grateful for having lost his troublesome tormentors without pain.

CASE 10.—A man, ætat 56, weighing seventeen stone, of muscular frame, fell and injured his shoulder. He applied at the hospital eleven hours after, and there was found a dislocation of the humerus into the axilla. He was placed in a chair in the sitting posture. Ether vapour was administered to him, and whilst he was under its influence, extension was made on the humerus, and the arm carried over the chest, when the head of the bone was immediately restored to the glenoid cavity. Another dislocation of a fortnight's standing was almost

as readily reduced whilst the patient was under the influence of ether.

CASE 11.—A young man, ætat 24, with diseased finger from the bite of a rat, was placed under the influence of ether, and his finger was amputated. After the operation he described the cutting of the skin and the division of the bone, but he had suffered no pain. This is one of the numerous cases in which the patient was insensible to pain, but had not lost consciousness.

CASE 12.—A young lady was placed under the influence of ether. I extracted a molar of the lower jaw, which produced no pain, but she described the sensation as similar to that which is felt when the finger of one hand is embraced closely by the other and then drawn out. This, like the last case, proves that insensibility to pain precedes the loss of consciousness.

CASE 13.—A man applied at the hospital with tooth-ache, who told us he was of Jewish extraction, but is now converted to Christianity, and is a popular Smithfield orator. On having the influence of ether vapour on the system explained to him, he consented to inhale it, as he expressed, from philanthropic motives. He readily became inebriated,

when I performed the operation. As he recovered, he fancied himself addressing his usual audience, and, using gesticulations not understood here, induced several gentlemen to retreat into the rear. He afterwards gave us an account of a pleasant dream he had had. He fancied himself in an elegant apartment surrounded by everything beautiful and lovely, with his hand in a bag so full of happiness that he could not reach the bottom of it; in fact, he was so much delighted that he wished to have another dose, that he might again realize such joyous feelings.

CASE 14.—A man who was to be bled from the arm to 3xij., had half that quantity abstracted, and then commenced inhaling: when he became insensible, the remainder was drawn. The latter quantity was decidedly darker than the former and coagulated much sooner.

I mention this case with a view of contradicting the assertion of those who maintain that the blood in such cases is more fluid than natural.

Insensibility to pain, though itself most invaluable, is not the only benefit to be derived from the use of ether vapour. Case No. 10 is an example showing the assistance to be derived from its use in

the reduction of dislocations, seeing that this case is one of the most unfavourable of its kind ; and it seems but fair to ascribe the success to the action of the ether in producing such utter prostration of muscular energy,* thus overcoming the main obstacle to the reduction of dislocations in general. The same remarks apply to all cases where muscular action becomes an impediment to success. I need hardly allude to the advantages of having the patient in a quiet and manageable state during the performance of the more delicate operations of surgery.

Many other advantages from its use may be surmised, but it were idle to dwell on them till time shall afford us opportunities of substantiating them by the test of experience.

I believe it is still a question how it influences a patient as regards the immediate effect or “ shock ” of a severe operation. One or two cases have been published where the ether has been administered in which the patients have gradually sunk in a state of collapse, having never rallied ; and their authors seem willing to ascribe this result to the ether. It

* See a paper, by the Author, in the *Medical Gazette*, February 5.

is not uncommon for patients to sink after severe operations, and this without an evident cause, even where they have previously appeared favourable subjects for success ; and that circumstance, together with the failure of the *post mortem* examinations to disclose any effects which may be fairly ascribed to the ether, leads me to think that these cases ought not to be considered as proving anything with regard to the ether, except that its immediate end was fully answered. Certainly more evidence on this point is required ; and at present much the greater portion—indeed, with these exceptions, the whole—is, to a greater or less degree, on the opposite side. The number of cases in which ether has been administered is now great, and the facts observed are also many, and it is from these that principles for our guidance in future are to be obtained ; and to this end ought our inquiries rather to tend, than to be content with collecting a heap of uninstrusive and useless cases, for “ we must never forget that it is principles, not phenomena, laws, not insulated, independent facts, which are the objects of inquiry.”*

* Herschell's Discourse, p. 13, 14.

*The Apparatus described is manufactured and sold by
DANIEL FERGUSON, Instrument-maker to St. Bartholo-
mew's Hospital.*

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Price, complete	2	2	0
In Mahogany Case, with Stopper-bottle for Ether	3	3	0
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